

AMENDMENTS TO THE CLAIMS

Please replace all prior versions of the claims with the following claim listing:

Claims:

1-6. (Cancelled)

7. (Currently Amended) An alignment system for aligning an end of an optical fiber with an input of an optical waveguide of an optical device, the system comprising:

a lens that receives light from an output of the optical waveguide, and focuses the received light into a light beam, the optical waveguide corresponding to an optical path extending from the input of the optical waveguide, through the optical device to the output of the optical waveguide;

a single optical sensor, the optical sensor receiving the focused light beam, the optical sensor converting the light beam focused thereon by the lens into corresponding electrical signals; and

processing logic, the processing logic receiving the electrical signals and processing the electric signals to determine whether or not said end of the optical fiber is aligned with the input of the optical waveguide;

wherein if the processing logic determines that said end of the optical fiber is not aligned with the input of the optical waveguide, the processing logic generates a feedback signal that is sent to a motion control system that controls the spatial positioning of the end of the optical fiber, and wherein when the feedback signal is received by the motion control system, the motion control system adjusts a spatial positioning of the end of the optical fiber in accordance with the received feedback signal;

wherein the single optical sensor is a single photodiode, and wherein the lens focuses the light received thereby from the output of the optical waveguide onto the photodiode and the photodiode converts the light focused thereon into said corresponding electrical signals that are processed by the processing logic to determine whether or not the end of the optical fiber is aligned with the input of the optical waveguide, the photodiode being capable of seeing outputs of multiple optical waveguides;

wherein the processing logic determines whether or not the end of the optical fiber is aligned with the input of the optical waveguide by performing an alignment algorithm, and wherein the alignment algorithm receives the electrical signals generated by the single photodiode after the electrical signals generated by the photodiode have been processed by an electrical processing circuit of the processing logic, and wherein the alignment algorithm analyzes the processed electrical signals and determines whether or not the end of the optical fiber is aligned with the input of the optical waveguide, wherein if the alignment algorithm determines that the end of the optical fiber is not aligned with the input of the optical waveguide, the processing logic performing the alignment algorithm generates and sends a feedback signal to the motion control system that cause the motion control system to adjust the spatial positioning of the end of the optical fiber; and

The alignment system of claim 6, wherein, in order to determine whether the end of the optical fiber is aligned with the input of the optical waveguide, the motion control system causes the end of the optical fiber to be scanned across one or more layers of the optical device in accordance with the feedback signals received by the motion control system until the processing logic determines that a layer in which the optical waveguide exists has been found, and wherein after the processing logic determines that the layer in which the optical waveguide exists has been found, the processing logic generates and sends feedback signals to the motion control system to cause the motion control system to scan the end of the optical fiber along the layer in which the optical waveguide exists until the processing logic determines the location of the input of the optical waveguide within the layer in which the optical waveguide has been determined to exist.

8. (Original) The alignment system of claim 7, wherein, in addition to the electrical processing circuit, the processing logic comprises:

an analog-to-digital converter (ADC) that converts the output of the electrical processing circuit into a digital signal; and

a computer in communication with the ADC, the computer receiving the digital signal from the ADC, the computer performing the alignment algorithm, the alignment algorithm processing the digital signals received from the ADC to

determine whether or not the spatial positioning of the end of the optical fiber is aligned with the input of the optical waveguide.

9. (Original) The alignment system of claim 8, wherein the processing logic further comprises:

a differential operational amplifier, the differential operational amplifier receiving two signals from the electrical processing circuit and obtaining a difference signal that corresponds to the difference between the two signals, the differential operational amplifier outputting the difference signal to the ADC.

10. (Original) The alignment system of claim 8, wherein the processing logic further comprises:

a memory element in communication with the computer, the memory element storing electrical signatures that correspond to layers of the optical device, and wherein the alignment algorithm compares stored signatures with the digital signals received from the ADC to determine when the layer in which the optical waveguide exists has been found so that the computer can send a feedback signal to the motion control system to cause the motion control system to stop scanning the end of the optical fiber across the layers of the optical device and to maintain the optical fiber at its current position.

11. (Original) The alignment system of claim 8, wherein the ADC is installed in the computer.

12. (Currently Amended) The alignment system of claim 8, wherein the ADC is located between the electrical processing circuit and the computer.

13. (Original) The alignment system of claim 8, wherein the ADC is comprised by the electrical processing circuit.

14. (Currently Amended) The alignment system of claim 8, wherein the electrical processing circuit comprises amplification circuitry and filtering circuitry, the amplification circuitry amplifying the electrical signals received from the single

photodiode, the filtering circuitry filtering noise out of the amplified electrical signals, the filtering ~~circuit~~ circuitry outputting the amplified and filtered electrical signals to the ADC, the ADC converting the amplified and filtered signals into digital signals that are input to the computer.

15. (Original) The alignment system of claim 8, wherein the alignment algorithm being performed by the computer produces information relating to magnitudes of the electrical signals output from the single photodiode as a function of the layers of the optical device while the end of the optical fiber is being scanned across the layers by the motion control system, and wherein the alignment algorithm determines which electrical signals output from the photodiode have the greatest magnitudes and, of the electrical signals having the greatest magnitude, which of the electrical signals is most likely to correspond to the layer in which the optical waveguide exists, wherein once the alignment algorithm determines which of the electrical signals is most likely to correspond to the layer in which optical waveguide exists, the alignment algorithm sends feedback signals to the motion control system to cause the motion control system to keep the position of the end of the optical fiber within the layer determined to be the layer in which the optical waveguide exists.

16. (Original) The alignment system of claim 15, wherein as the motion control system keeps the position of the end of the optical fiber within the layer determined to be the layer in which the optical fiber exists, the alignment algorithm generates feedback signals that cause the motion control system to move the end of the optical fiber over the layer determined to be the layer in which the optical fiber exists, wherein while the motion control system causes the end of the optical fiber to be scanned over the layer, the computer produces information relating to magnitudes of the electrical signals output from the single photodiode as a function of positions of the end of the optical fiber within the layer of the optical device in which the optical waveguide has been determined to exist, wherein the alignment algorithm determines which electrical signals output from the single diode correspond to the electrical signals of having greater magnitudes and, of the electrical signals that have the greatest magnitudes, the alignment algorithm differentiates between the electrical signals that have great magnitudes caused by noise and the electrical signal having the

greatest magnitude that does not correspond to noise, and wherein the alignment algorithm determines that the electrical signal having the greatest magnitude that does not correspond to noise is the input of the optical waveguide and that the end of the optical fiber is aligned with the input of the optical waveguide device.

17-20. (Canceled)

21. (Currently Amended) A method for aligning an end of an optical fiber with an input of an optical waveguide of an optical device, the method comprising the steps of:

receiving light from an output of the optical waveguide with a lens that focuses the received light into a light beam, the optical waveguide corresponding to an optical path extending from the input of the optical waveguide, through the optical device to the output of the optical waveguide;

focusing the light beam onto a single optical sensor;
converting, via the optical sensor, the light beam into corresponding electrical signals; and

processing the electrical signals produced by the optical sensor with processing logic to determine whether or not the end of the optical fiber is aligned with the input of the optical waveguide;

wherein if, during the processing step, a determination is made that the end of the optical fiber is not aligned with the input of the optical waveguide, the method further comprises the steps of:

generating a feedback signal;
sending the feedback signal to a motion control system that controls the motion and positioning of the end of the optical fiber; and
adjusting a spatial positioning of the end of the optical fiber in accordance with the feedback signal received by the motion control system;
wherein the focusing, converting, processing, generating, sending and adjusting steps are performed until a determination is made that the end of the optical fiber is aligned with the input of the optical waveguide; and

The method of claim 19, wherein, in order to determine whether the end of the optical fiber is aligned with the input of the optical waveguide, the motion control

system causes the end of the optical fiber to be scanned across one or more layers of the optical device in accordance with the feedback signals received by the motion control system until the processing logic determines that a layer in which the optical waveguide exists has been found.

22. (Original) The method of claim 21, wherein if, during the processing step, the processing logic determines that the layer in which the optical waveguide exists has been found, the steps of generating and sending feedback signals and the step of adjusting the spatial positioning of the end of the optical fiber are performed with respect to the layer in which the optical waveguide has been determined to exist such that the motion control system causes the end of the optical fiber to be scanned along the layer in which the optical waveguide has been determined to exist until a determination is made that the location of the input of the optical waveguide within the layer in which the optical waveguide exists has been found.

23-25. (Canceled)

26. (New) The method of claim 21, wherein the single optical sensor is a single photodiode.

27. (New) An alignment system for aligning an end of an optical fiber with an input of an optical waveguide of an optical device, the alignment system comprising:

a lens configured to receive light from an output of the optical waveguide and focuses the received light into a light beam;

an optical sensor configured to receive the focused light beam and convert the light beam into corresponding electrical signals;

processing logic configured to receive the electrical signals and process the electric signals to determine whether or not the end of the optical fiber is aligned with the input of the optical waveguide, the processing logic further configured to generate feedback signals; and

a motion control system configured to receive the feedback signals and control the spatial positioning of the end of the optical fiber in accordance with the feedback signals;

wherein, in order to determine whether the end of the optical fiber is aligned with the input of the optical waveguide, the processing logic generates and sends feedback signals to the motion control system to cause the motion control system to scan the end of the optical fiber across one or more layers of the optical device until the processing logic determines that a layer in which the optical waveguide exists has been found, and wherein after the processing logic determines that the layer in which the optical waveguide exists has been found, the processing logic generates and sends feedback signals to the motion control system to cause the motion control system to scan the end of the optical fiber along the layer in which the optical waveguide exists until the processing logic determines the location of the input of the optical waveguide within the layer in which the optical waveguide has been determined to exist.

28. (New) The alignment system of claim 27, wherein the motion control system comprises a plurality of drive motors, a first drive motor configured to scan the end of the optical fiber in an X direction by a predetermined step, a second drive motor configured to scan the end of the optical fiber in a Y direction by a predetermined step.

29. (New) The alignment system of claim 28, wherein the predetermined step includes a length of 0.01 millimeters.

30. (New) The alignment system of claim 27, wherein the processing logic comprises means for accounting for the Gaussian distribution of light.

31. (New) A method for aligning an end of an optical fiber with an input of an optical waveguide of an optical device, the method comprising the steps of:

receiving light from an output of the optical waveguide with a lens that focuses the received light into a light beam, the optical waveguide corresponding to an optical path extending from the input of the optical waveguide, through the optical device to the output of the optical waveguide;

focusing the light beam onto a single optical sensor;
converting, via the optical sensor, the light beam into corresponding electrical signals;
processing the electrical signals produced by the optical sensor to determine the voltage level of the electrical signals;
generating feedback signals based on the voltage level of the electrical signals;
sending the feedback signal to a motion control system configured to position the end of the optical fiber;
adjusting a spatial positioning of the end of the optical fiber in accordance with the feedback signal received by the motion control system;
causing the motion control system to scan the end of the optical fiber across one or more layers of the optical device until the processing logic determines that a layer in which the optical waveguide exists has been found; and
causing the motion control system to scan the end of the optical fiber along the layer in which the optical waveguide exists until the processing logic determines the location of the input of the optical waveguide within the layer in which the optical waveguide has been determined to exist.

32. (New) The method of claim 31, wherein causing the motion control system to scan further comprises scanning within a predefined window.

33. (New) The method of claim 32, wherein the window is approximately 50 microns by 200 microns.

34. (New) The method of claim 31, wherein causing the motion control system to scan comprises causing the motion control system to step by increments of about 0.01 millimeters.

35. (New) The method of claim 31, wherein the processing logic determines the location of the input of the optical waveguide within the layer in which the optical waveguide has been determined to exist by determining a peak voltage of the voltage level of the electrical signals.